ROZPRAWY INŻYNIERSKIE • ENGINEERING TRANSACTIONS • 34, 1-2, 3-13, 1986
Polska Akademia Nauk • Instytut Podstawowych Problemów Techniki

SH WAVES IN A POROUS LAYER OF NONUNIFORM THICKNESS

A. CHATTOPADHYAY, M. CHAKRABORTY and N. P. MAHATA (DHANBAD)

The paper is concerned with the propagation of SH-waves due to momentary point sources, in a porous layer of nonuniform thickness resting on an isotropic elastic homogeneous half-space. Green's function techniques have been applied to solve the problem. The effects of porosity and nonuniformity on the displacement are distinctly marked. The possible condition creating fracture in the medium has also been derived. The graphs for the critical velocities of waves creating fracture in the medium versus thickness of the layer above the origin have been plotted at different modes.

1. Introduction

The theory of propagation of elastic waves in a fluid saturated porous solid was presented by Biot [1]. In his theory he has shown that in such a medium there are two dilatational waves. Later on, basing on this theory, many authors studied the problem of wave propagation in such media. Deresiewicz [2] has considered the effect of boundaries on the reflection of plane waves at a free plane in a liquid filled porous solid whereas Deresiewicz and Rice [3] have investigated the general case of reflection of plane waves in a liquid filled porous solid. Bose [4] discussed wave propagation in the marine sediments of water saturated soils. The propagation of Rayleigh waves in porous elastic saturated solid has been discussed by Jones [5]. In fluid saturated porous cylinders, Gardner [6] has shown the effect of extensional waves. Paul [7] has considered the displacement produced in a porous elastic half-space by an impulsive line load. Chattopadhyay and De [8] studied Love type waves in a porous layer with an irregular interface.

The propagation of SH-type waves in layered media with nonuniform thickness in a crystal layer have been discussed by many authors, viz. Sato [9], De Noyer [10], Mal [11], Bhattacharya [12], Chattopadhyay [13] and many others. Recently, Chattopadhyay, Chakraborty and Pal [14], Chakraborty, Chattopadhyay and Dey [15] have studied the propagation of SH-type waves in a transition layer (in a state of initial stress or free from initial stress) with parabolic irregularity in the lower interface whereas CHATTOPADHYAY and DE [16] have considered the problem of propagation of Love waves in an initially stressed visco-elastic layer of rectangular irregular interface with Voigt-type half-space. CHATTOPADYAY and MAHATA [17] have studied the propagation of Love waves on a cylindrical model. They have pointed out that the proper matching of the observational data with theoretical dispersion curves, the length of the corrugation as well as the inhomogeneous character may be obtained.

The present paper deals with the SH-wave propagation in a porous layer of nonuniform thickness (Fig. 1). The common boundary between the

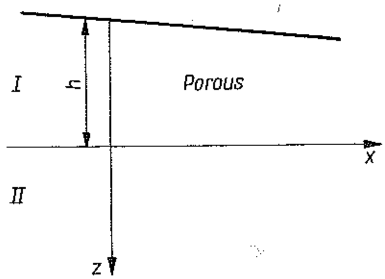

FIG. 1. Geometry of the problem.

layer and homogeneous isotropic elastic half-space has been taken as horizontal. The source of disturbance generating SH-waves is assumed as the momentary point source located in the half-space very close to the origin. The problem is solved by applying Green's function technique indicated by COVERT [18]. The analysis presented here shows that the porosity and non-uniformity in the layer play a very important role in the propagation of SH-waves. The condition under which the fracture in the material may take place has also been derived and the critical velocities of the wave causing fracture for different values of thickness of the layer above the origin have also been calculated numerically and presented by graphs.

2. MATHEMATICAL DERIVATIONS

For SH-wave propagation the only nontrivial equation of motion for the porous layer is (BIOT (1956), CHATTOPADHYAY (1983))

$$\nabla^2 V = \frac{1}{C_N^2} \frac{\partial^2 V}{\partial t^2}, \tag{1}$$

where

(2) $$C_N = \sqrt{(N/b)}, \quad b = \varrho_{11} - \frac{\varrho_{12}^2}{\varrho_{22}},$$

and

(3) $$\nabla^2 = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial z^2}.$$

Here N corresponds to the familiar Lamé constant and ϱ_{11}, ϱ_{12}, ϱ_{22} are the mass coefficients related to the densities ϱ, ϱ_s, ϱ_f of the layer, solid and fluid, respectively.

For the lower isotropic medium II the equation is

(4) $$\nabla^2 V = \frac{\varrho_2}{\mu_2} \frac{\partial^2 V}{\partial t^2}.$$

Taking the time-dependent proportional to $e^{i\omega t}$, the equation for media I and II are,,respectively,

(5) $$\nabla^2 V_1 + K_1^2 V_1 = 0,$$

and

(6) $$\nabla^2 V_2 + K_2^2 V_2 = 0,$$

where

(7) $$K_1^2 = \frac{\omega^2}{C_N^2} \quad \text{and} \quad K_2^2 = \frac{\omega^2 \varrho_2}{\mu_2}.$$

The boundary conditions are
(i) at the free surface

(8) $$N \frac{\partial V_1}{\partial x} \sin\theta - N \frac{\partial V_1}{\partial z} \cos\theta = 0;$$

(ii) at the interface $z = 0$

(9) $$\text{(a)} \quad V_1 = V_2$$

and

(10) $$\text{(b)} \quad N \frac{\partial V_1}{\partial z} = \mu_2 \frac{\partial V_2}{\partial z}.$$

We propose to solve Eqs. (5) and (6) under the prescribed boundary conditions (8)—(10) using Green's function technique. The method of finding Green's function of such composite media was indicated by COVERT [18]. We are interested in the displacement on the surface and so we shall try to find $G(x, z/0, 0)$ for body I viz., the upper layer.

Let G_1 and G_2 be Green's function for media I and II under the boundary conditions $\partial G_1/\partial n_1 = \partial G/\partial n_2 = 0$ at the interface and $G_1 = 0$ at the free surface, n_1, n_2 correspond to the normal drawn outwards from the upper and lower medium respectively. Green's function $G_1(r/r_0)$ for the upper medium satisfies the inhomogeneous Helmhotz equation

$$\nabla^2 G_1(r/r_0) + K^2 G_1(r/r_0) = -4\pi\delta(r-r_0), \tag{11}$$

where $G_1(r/r_0)$ is the value of Green's function at $r(x, z)$ for a unit point source at $r_0(x_0, y_0)$. Similarly we have the equation for G_2.

We have for a general source distribution of densities $\varrho_1'(r)$ and $\varrho_2'(r)$ in the upper and lower medium respectively. (cf. MORSE and FESHBACK [19]),

$$V_1(r) = \int G_1(r/r_0)\,\varrho_1'(r_0)\,dV_0 + \frac{1}{4\pi}\int_{AB} G_1(r/r_s)\,\frac{\partial V_1(r_s)}{\partial n_1}\,dS_{01}, \tag{12}$$

$$V_2(r) = \int G_2(r/r_0)\,\varrho_2'(r_0)\,dV_{02} + \frac{1}{4\pi}\int_{AB} G_2(r/r_s)\,\frac{\partial V_2(r_s)}{\partial n_2}\,dS_{02}, \tag{13}$$

where $r_s(x_s, 0)$ is a point on the interface and integration is taken over all the points $(x_s, 0)$ on the interface. The conditions $\partial G_1/\partial n_1 = \partial G_2/\partial n_2$ at the interface are employed in Eqs. (12) and (13).

Using the boundary conditions (9) and (10) we have at a point $r_1(x_1, 0)$ on AB

$$\frac{1}{4\pi}\int_{AB}\left[G_1(r_1/r_s) + \frac{N}{\mu_2}G_2(r_1/r_s)\right]\frac{\partial V_1}{\partial n_1}\,dx_s + \tag{14}$$
$$+\int G_1(r_1/r_0)\,\varrho_1'(r_0)\,dV_{01} - \int G_2(r_1/r_0)\,\varrho_2'(r_0)\,dV_{02} = 0.$$

If the point source lies very near the origin but in the medium II, then $\varrho_1' = 0$, $\varrho_2 = \delta(r-r_0)$. Hence $r_0(0, 0)$ denotes the source point which is the origin. Under these circumstances V_1 and V_2 become Green's function in the respective bodies. Then Eq. (14) becomes

$$G_2(r_1/0) = \frac{1}{4\pi}\int_{AB}\left[G_1(r_1/r_s) + \frac{N}{\mu_2}G_2(r_1/r_s)\right]\frac{\partial G(r_s/0)}{\partial z}\,dx_s, \tag{15}$$

where G is the proper Green's function for a body corresponding to the source in the medium II. From Eq. (12) we get Green's function for the upper layer as

$$G_1 = \frac{1}{4\pi}\int_{AB} G_1(r/r_s)\,\frac{\partial G(r_s/0)}{\partial z}\,dx_s. \tag{16}$$

Now $[\partial G(r_s/0)]/\partial z$ can be obtained from the integral equation (15) and after the substitution of this value in Eq. (16), we determine Green's function for the upper layer completely.

If a source is situated in the medium II, Green's function G_1 for the upper layer corresponding to the boundary conditions $\partial G_1/\partial n_1$ at the interface and $G_1 = 0$ at the upper boundary is obtained by the method of reflection in the form

$$G_1(x, z/0, 0) = 2i\left[H_0^{(1)}\{K_1\sqrt{(x^2+z^2)}\} + H_0^{(1)}\{K_1\sqrt{[(x-2h\theta)^2 + (z+2h)^2]} + H_0^{(1)}\{K_1\sqrt{[(x-2h\theta)^2+(z-2h)^2]}\} + H_0^{(1)}\{K_1\sqrt{[(x-8h\theta)^2+(z+4h)^2]}\} + H_0^{(1)}\{K_1\sqrt{[(x-8h\theta)^2+(z-4h)^2]}\} + \ldots\right].$$

where the reflected points are $(2h\theta, -2h)$, $(2h\theta, 2h)$, $(8h\theta. 4h)$, $(8h\theta, 4h)$, $(18h\theta, -6h)$, $(18h\theta, 6h)$, ... to the first powers in θ and $H_0^{(1)}$ is the Hankel function of the first kind of order zero. Using the integral representation of $H_0^{(1)}(K_1 r/r_0)$ in the form.

$$H_0^{(1)}(K_1 r/r_0) = \frac{1}{\pi i}\int_{-\infty}^{\infty} \frac{\exp\left(if(x-x_0) - \alpha(y-y_0)\right)}{\alpha}\, df,$$

where $y - y_0 > 0$ and $\alpha^2 = f^2 - K_1^2$ (cf. MORSE and FESHBACH [19]), we get

$$G_1(x, z/0, 0) = \frac{1}{2\pi}\left[\int_{-\infty}^{-} \frac{\exp(ifx + \alpha z)}{\alpha}\, df + \int_{-\infty}^{\infty} \frac{\exp\{if(x-2h\theta) - \alpha(z+2h)\}}{\alpha}\, df + \int_{-\infty}^{\infty} \frac{\exp\{if(x-2h\theta) - \alpha(2h-z)\}}{\alpha}\, df + \int_{-\infty}^{\infty} \frac{\exp\{if(x-8h\theta) - \alpha(z+4h)\}}{\alpha}\, df + \ldots\right].$$

which, when expanded up to first power of θ (assuming $|f\theta|$) to be always small, becomes

(17) $$G_1(x, z/0, 0) = \frac{2}{\pi} \int_{-\infty}^{\infty} \left[\frac{\exp(\alpha z) + \exp(-\alpha(z+2h))}{1 - e^{-2h\alpha}} - 2ifh\theta \frac{e^{-2h\alpha}(1 + e^{-2h\alpha})}{(1 - e^{-2h\alpha})^3} \{\exp(\alpha z) + \exp(-\alpha z)\} \right] \frac{e^{ifx}}{\alpha} df.$$

Now we will substitute $(h - x_s\theta)$ and $(x - x_s)$ for h and x in Eq. (17) for the calculation of $G_1(x, z/x_s, 0)$. $x_s\theta$ is small as compared to h for all x_s for which there is a significant contribution to the value of the required Green's function. We therefore ignore the term containing $x_s\theta$ and thereby obtain

(18) $$G_1(x, z/x_s, 0) = \frac{2}{\pi} \int_{-\infty}^{\infty} \frac{e^{if(x-x_s)}}{\alpha} \left[\frac{\exp(\alpha z) + \exp(-\alpha(z+2h))}{1 - e^{-2h\alpha}} - 2ifh\theta \{\exp(\alpha z) + \exp(-\alpha z)\} \frac{e^{-2h\alpha}(1 + e^{2h\alpha})}{(1 - e^{-2h\alpha})^3} \right] df.$$

So that $G_1(x, z/x_s, 0)$ at a point $(x_1, 0)$ on the interface is

(19) $$G_1(x_1, 0/x_s, 0) = \frac{2}{\pi} \int_{-\infty}^{\infty} \frac{\exp(if(x_1 - x_s))}{\alpha} \times \left[\frac{1 + e^{-2h\alpha}}{1 - e^{-2h\alpha}} - 4ifh\theta \frac{e^{-2h\alpha}(1 + e^{-2h\alpha})}{(1 - e^{-2h\alpha})^3} \right] df.$$

Now, if a source is situated at a point $(x_s, 0)$ on the boundary, where $\beta^2 = f^2 - K_2^2$, from which $G_2(x, z/x_s, 0)$ at a point $(x_1, 0)$ on the interface is given by

(20) $$G_2(x_1, 0/x_s, 0) = \frac{2}{\pi} \int_{-\infty}^{\infty} \frac{\exp(if(x_1 - x_s))}{\beta} df.$$

Substituting the values of $G_1(x_1, 0/x_s, 0)$, $G_2(x_1/x_s, 0)$ and $G_2(x_1, 0/0, 0)$ in Eq. (15) and then, after some mathematical calculations, we obtain

$$\frac{1}{4\pi} \int_{-\infty}^{\infty} e^{-ifx_s} \frac{\partial G}{\partial z}(x_s, 0/0, 0)\, dx_s =$$

$$= \frac{1}{\beta \left[\frac{N}{\mu_2 \beta} + \frac{1 + e^{-2h\alpha}}{\alpha(1 - e^{-2h\alpha})} - 4ifh\theta \frac{e^{-2h\alpha}(1 + e^{-2h\alpha})}{\alpha(1 - e^{-2h\alpha})^3} \right]}.$$

Now, applying the Fourier inverse transform and then using binomial expansion, we get

$$\frac{\partial G}{\partial z}(x_s, 0/0, 0) = 2 \int_{-\infty}^{\infty} \frac{e^{ifx_s}\, df}{\beta \left[\frac{N}{\mu_2 \beta} + \frac{1+e^{-2h\alpha}}{\alpha(1-e^{-2h\alpha})} \right]} + \tag{21}$$

$$+2 \int_{-\infty}^{\infty} 4ifh\theta \frac{e^{ifx_s} e^{-2h\alpha} (1+e^{-2h\alpha})}{\beta\alpha (1-e^{-2h\alpha})^3 \left[\frac{N}{\mu_2 \beta} + \frac{1+e^{-2h\alpha}}{\alpha(1-e^{-2h\alpha})^2} \right]^2} df,$$

where θ^2 and higher powers of θ have been neglected. Substituting the values of $G_1(x, z/x_s, 0)$, $G(x_s, 0/0, 0)$ from Eqs. (18) and (21) in Eq. (16) and using the results

$$\delta(f'-f) = \frac{1}{2\pi} \int_{-\infty}^{\infty} \exp(i(f'-f)x_s)\, dx_s$$

and

$$\int g(f')\,\delta(f'-f)\, df' = g(f),$$

where we have taken $f'-f=\eta$, so that $df' = d\eta$, we obtain after simplification

$$G(x, z/0, 0) = \frac{2\mu_2}{\pi} \int_{-\infty}^{\infty} e^{ifx} \frac{\exp(\alpha(z+h)) + \exp(-\alpha(z+h))}{N\alpha(e^{h\alpha}-e^{-h\alpha}) + \mu_2 \beta (e^{h\alpha}+e^{-h\alpha})} df + \tag{22}$$

$$+\frac{4ifh\theta}{\pi} \int_{-\infty}^{\infty} f e^{ifx} \frac{e^{h\alpha}+e^{-h\alpha}}{e^{h\alpha}-e^{-h\alpha}} [\mu_2 \beta \{\exp(\alpha z) - \exp(-\alpha z)\} -$$

$$- N\alpha \{\exp(\alpha z) + \exp(-\alpha z)\}]\, df / [N\alpha(e^{h\alpha}-e^{-h\alpha}) + \mu\beta(e^{h\alpha}+e^{-h\alpha})]^2.$$

Now writing $\alpha = i\alpha_i$ where $\alpha_1 = (K_1^2 - f^2)^{1/2}$ Eqs. (22) becomes

$$G(x, z/0, 0) = \frac{2\mu_2}{\pi} \int_{-\infty}^{\infty} e^{ifx} \frac{\cos \alpha_1 (z+h)}{\mu_2 \beta \cos \alpha_1 h - N \alpha_1 \sin \alpha_1 h} df + \tag{23}$$

$$+\frac{2i\mu_2 \theta h}{\pi} \int_{-\infty}^{\infty} f e^{ifx} \frac{\cos \alpha_1 h (\mu_2 \beta \sin \alpha_1 z - N\alpha_1 \cos \alpha_1 z)}{\sin \alpha_1 h (\mu_2 \beta \cos \alpha_1 h - N\alpha_1 \sin \alpha_1 h)^2} df,$$

which is the expression for SH displacement at a point corresponding to a source in the lower medium but very near to the origin. This type of integral has already been evaluated by SEZAWA [22]. In order to evaluate the integral, we choose the contour as the real axis and infinite semi-circle in the upper half plane with necessary cuts at the branch points $f=K_1, K_2$. The solution can then be expressed as the sum of residues of integrands and two integrals along branch lines corresponding to the branch points $f=K_1$ and $f=K_2$. The branch line integrals are $0(x^{-3/2})$ and become negligible for large x. Therefore, neglecting the contributions of the branch line integrals, we find for large values of x,

$$(24) \qquad \frac{2\mu_2}{\pi}\int_{-\infty}^{\infty} e^{if}\, x\, \frac{\cos\alpha_1(z+h)}{\mu_2\beta\cos\alpha_1 h - N\alpha_1\sin\alpha_1 h}\, df = $$

$$= 4\mu_2\, i\sum_n e^{if}\, n^x\, \frac{\cos\alpha_{1n}(z+h)}{F'(f_n)},$$

where

$$(25) \qquad F(f) = \mu_2(f^2-K_2^2)^{1/2}\cos\left(\sqrt{(K_1^2-f^2)}\right)h -$$
$$- N(K_1^2-f^2)^{1/2}\sin\left(\sqrt{(K_1^2-r^2)}\right)h,$$

so that $f_n\,(n=1,2,3\,...)$ are the roots of the Eq.

$$(26) \qquad F(f_n) = \mu_2(r_n^2-K_2^2)^{1/2}\cos\left(\sqrt{(K_1^2-f_n^2)}\right)h -$$
$$- N(K_1^2-f_n^2)^{1/2}\sin\left(\sqrt{(K_1^2-f_n^2)}\right)h = 0,$$

and

$$\alpha_{1n} = (K_1^2-f_n^2)^{1/2}.$$

Similarly, the second integral of Eq. (23)

$$(27) \qquad = \frac{2i\mu_2\,\theta h}{\pi}\int_{-\infty}^{\infty} f e^{ifx}\,\frac{\cos\alpha_1 h(\mu_2\beta\sin\alpha_1 z - N\alpha_1\cos\alpha_1 z)}{\sin\alpha_1 h(\mu_2\beta\cos\alpha_1 h - N\alpha_1\sin\alpha_1 h)^2}\, df =$$

$$= \frac{2i\mu_2\,\theta h}{\pi}(2\pi i) \quad \text{sum of the residues}$$

$$= -4\mu_2\,\theta h\sum_n \frac{\frac{d}{df}\left[f e^{ifx}\cot\alpha_1 h(\mu_2\beta\sin\alpha_1 z - N\alpha_1\cos\alpha_1 z)\right]_{f=fn}}{[F(f_n)]^2}\, df +$$

$$+ 4\mu_2\,\theta h\sum_n \frac{f_n e^{if}\, n^x\cot\alpha_{1n} h(\mu_2\beta_n\sin\alpha_{1n} z - N\alpha_{1n}\cos\alpha_{1n} z)}{F'(f_n)]^3}\, F''(f_n) -$$

$$-4\mu_2\,\theta h\sum_m \frac{\alpha_{1m}}{\mu_2^2\beta_m^2}\, e^{if}\, m^x\left[\mu_2\beta_m\sin\alpha_{1m} z - N\alpha_{1m}\cos\alpha_{1m} z\right],$$

where α_{1m} are given by $\sin\alpha_{1m} h = 0$ giving $\alpha_{1m} h = m\pi$ $(m = 1, 2, 3 \ldots)$ and f_m' are the correspondin g values of f and β.

Since θ is small, for large values of x, the important contribution comes from the first summation of Eq. (27) in the form

$$-4i\mu_2 \theta h \sum_n x f_n e^{if} n^x \frac{\cot\alpha_{1n} h (\mu_2 \beta_n \sin\alpha_{1n} z - N\alpha_{1n} \cos\alpha_{1n} z)}{[F'(f_n)]^2} =$$

$$= 4i\mu_2 \theta h \sum_n \frac{x f_n e^{if} n^x}{[F'(f_n)]^2} \frac{N\alpha_{1n}}{\sin\alpha_m h} \cos\alpha_{1n} (z+h).$$

Equation (26) can be written as

(28) $$\mu_2 \beta_n \cos\alpha_{1n} h - N\alpha_{1n} \sin h = 0,$$

which is the modified dispersion equation of the SH-waves for the model considered. Hence for large values of x,

(29) $$G(x, z/0, 0) \approx 4\mu_2 i \sum_n e^{if} n^x \frac{\cos\{\alpha_{1n}(z+h)\}}{F'(f_n)} +$$

$$+4i\mu_2 \theta h \sum_n \frac{x f_n e^{if} n^x}{[F'(f_n)]^2} \frac{N\alpha_{1n}}{\sin(\alpha_{1n} h)} \cos\{\alpha_{1n}(z+h)\} =$$

$$= 4\mu_2 i \sum_n \frac{e^{if} n^x \cos\{\alpha_{1n}(z+h)\}}{F'(f_n)} \left(1 + \frac{N\alpha_{1n} x f_n \theta h}{F'(f_n) \sin\alpha_{1n} h}\right).$$

The second term of Eq. (29) is due to the slope of the upper boundary, which is large when $\sin\alpha_{1n} h = 0$. This gives $\alpha_{1n} h = n\pi$ $(n = \pm 1, \pm 2, \ldots)$ from which we find

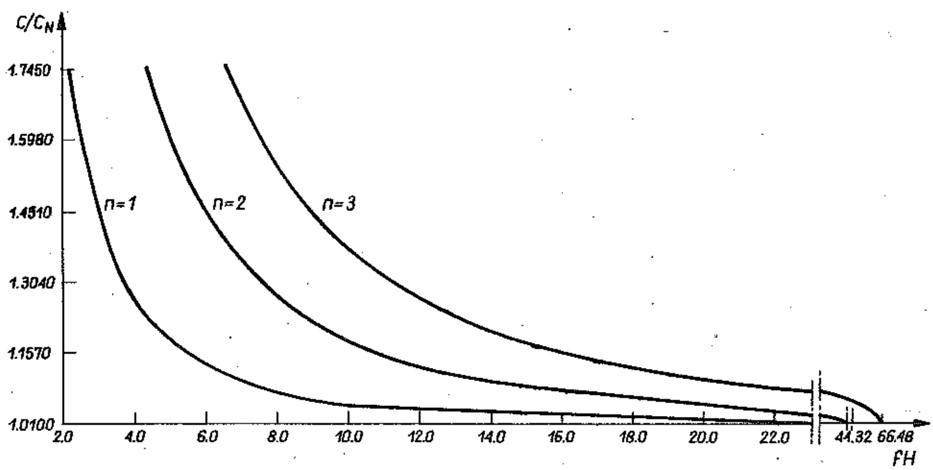

FIG. 2. C/C_N versus FH for different modes.

$$f_n = \frac{\left(\frac{\omega^2}{C_N^2} h^2 - n^2 \pi^2\right)^{1/2}}{h}. \tag{30}$$

Hence the displacement on the surface of the layer becomes infinite if the relation (30) holds. Hence we conjecture that large scale fracture may thus be caused. The critical values of C/C_N for different values of fh have been calculated numerically (from the condition (30) by replacing ω by fh) for different modes and presented by graphs in Fig. 2. From the graph it can be inferred that the fracture will take place in the material at less velocity of the wave if the values of fh increase.

Rererences

1. M. A. Biot, J. Acoust. Soc. Am., **28**, a) 168—178, b) 179—191, 1956.
2. H. Deresiewicz, Bull. Seism. Soc. Am., **50**, 4, 599—607, 1960.
3. H Deresiewicz and J. T. Rice, Bull. Seism. Soc. Am., **52**, 595, 1962.
4. S. K. Bose, Geof. Pura e Appl., p. 52—57, 1962.
5. J. P. Jones, J. Acoust. Soc. Am., **33**, 959, 1962.
6. G. H. F. Gardner, J. Acoust. Soc. Am. **34**, 1962.
7. S. Paul, Pure and Applied Geophysics, **114**, 605, 1976.
8. A. Chattopadhyay and R. K. De, Int. J. Engng. Sci., **21**, 11, 1295—1303, 1983.
9. Y. Sato, Bull. Earthq. Res. Inst., **30**, 101—120, 1962.
10. J. De Noyer, Bull. Seism. Soc. Am., **51**, 2, 227—235, 1961.
11. A. K. Mal, Geof. Pure Appl., **52**, 59—68, 1962.
12. J. Bhattacharya, Gerl. Beitr. Geophys., **71**, 6, 324—333, 1962.
13. A. Chattopadhyay, Bull. Cal. Math. Soc., **70**, 303—316, 1978.
14. A. Chattopodhyay, M. Chakraborty and A. K. Pal, J. Mecanique Theorique et Applique, **2**, 2, 215—225, 1983.
15. M. Chakraborty, A. Chattopadhyay and S. Dey, Indian J. Pure Appl. Math., **14**, 7, 850—863, 1983.
16. A. Chattopadhyay and R. K. De, Rev. Raum. Soc. Techn. Mech. Appl., **26**, 3, 449—460, 1981.
17. A. Chattopadhyay and N. P. Mahata, J. Acoust. Soc. Am., **74**, 386—293, 1983.
18. E. D. Covert, J. Math. Phys. **37**, 58—65, 1958.
19. P. M. Morse, H. Freshbach, McGraw Hill Book. Co Ind., London 1953.
20. K. Sezawa, Bull. Earthquake Res. Inst., **13**, 1—17, Tokyo 1935.

Streszczenie

FALE POPRZECZNE W WARSTWIE POROWATEJ O ZMIENNEJ GRUBOŚCI

Rozważono propagację fal poprzecznych wywołanych chwilowymi źródłami punktowymi w porowatej warstwie o nierównomiernej grubości, spoczywającej na izotropowej jednorodnej półprzestrzeni sprężystej. Zastosowano metodę funkcji Greena. Stwierdzono istotny wpływ porowatości i zmiennej grubości warstwy na przemieszczenia. Wyprowadzono również warunek pękania ośrodka. Przedstawiono wykresy zależności między krytycznymi prędkościami fal powodującymi pękanie a grubością warstwy.

Резюме

ПОПЕРЕЧНЫЕ ВОЛНЫ В ПОРИСТОМ СЛОЕ ПЕРЕМЕННОЙ ТОЛЩИНЫ

Рассмотрено распространение поперечных волн, вызванных мгновенными точечными источниками в пористом слое с неравномерной толщиной, находящемся на изотропном однородном упругом полупространстве. Применен метод функции Грина. Констатировано существенное влияние пористости и переменной толщины слоя на перемещения. Выведено тоже условие разрушения среды. Представлены диаграммы зависимости между критическими скоростями волн, вызывающими разрушение, и толщиной слоя.

DEPARTMENT OF PHYSICS AND MATHEMATICS
INDIAN SCHOOL OF MINES, DHANBAD, INDIA

Received April 2, 1984.